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Restricted Feeding of Growing Pullets

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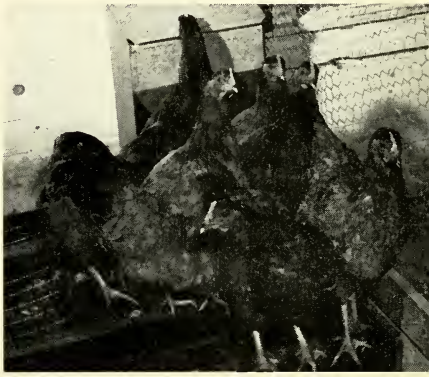

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Cover

New Hampshire pullets reared in confinement at twenty weeks of age: left, full fed pullets; right, restricted fed pullets.

Restricted Feeding of Growing Pullets

By R. C. Ringrose*

Introduction

POULTRYMEN are still seeking an answer to the question, "Which is the best feeding system for my flock?" Those close to the problem realize that there is no "best" method for poultrymen as a group. Labor and management problems peculiar to a farm often dictate the choice of a feeding system.

During the past few years the terms restricted or controlled feeding have been employed to describe a method of feeding pullets grown for flock replacement. The main objective of such a feeding program is to delay sexual maturity and thereby increase initial egg size, which would result finally in the production of a larger number of hatching eggs. Additional advantages claimed are lower cost of rearing a pullet, reduction of adult mortality, and increased egg production.

As a result of breeding work aimed at developing strains of chickens which will grow rapidly to broiler age, such strains when reared for replacement pullets mature early and lay eggs of small initial size. It was felt by some poultrymen that if sexual maturity could be delayed, egg size not only would be increased, but more hatching eggs would be produced. Since the program of feeding to delay sexual maturity was a field development without comparative data, it was decided to obtain experimental data as an aid in evaluation and development of a system of feeding to delay sexual maturity.

Review of Literature

At the time this study was initiated, literature bearing on the subject was nonexistent. During the development of the research, a few reports appeared. Milby and Sherwood (1) reported a comparison of full feeding versus feeding limited to a definite number of hours daily. New Hampshire and White Plymouth Rock stock was reared in confinement. Growth was retarded and sexual maturity delayed about two weeks in both breeds by the restricted feeding program. The amount of feed required to rear a pullet to point of lay was virtually the same on both programs for the White Rocks and 1.8 pounds more for the New Hampshires on the restricted program. For the laying period there was little difference in egg production, egg weight, body weight, or mortality.

Sunde, Cravens, Bird, and Halpin (2) reared White Leghorn pullets by

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full feeding in confinement a "complete" and "incomplete" diet. The incomplete diet contained no animal protein, while the complete diet contained 3 percent condensed fish solubles and penicillin. Both diets were supplemented with vitamin B_{12}. Pullets fed the complete diet were heavier at 20 weeks of age and reached sexual maturity 10 to 12 days earlier. No effect on egg production, mortality, body weight, or hatchability was found. On any given calendar date egg weights were essentially the same. Apparently body weight and sexual maturity can be influenced with very little change in the diet fed.

Singsen, Matterson, Kozeff, and Stinson (3) reared Barred Plymouth Rock and New Hampshire pullets to eight to twelve weeks of age on a high efficiency diet. During the growing period, on an excellent mixed grass and clover range, high and low efficiency rations were fed both on a full feed and restricted basis. They state that the rations fed during the growing period had a very marked effect on efficiency of feed utilization and body weight to six months of age, no consistent effect on egg production or mortality, and only a slight effect on the size of eggs laid.

Davis and Watts (4) used a starting period of 10 weeks, a growing period to 20 weeks, and a laying period of 9 months. They studied mash-grain ratios of 70-30 and 30-70 and also restricted total feed. They report that starting treatment may affect laying performance but that growing treatment did not, except to delay sexual maturity. It is stated that egg size appears to be due primarily to age and that meat strain birds differ from egg strain birds in their response to different ration treatments.

Schneider, Bohren, and Anderson (5) compared the effects of a ration expected to promote fast growth with a ration expected to allow only slow growth. They found that restriction significantly reduced body weight but that four weeks following full feeding there was no difference in body weight. Sexual maturity was retarded 15 days when measured by average age at first egg, 27 days when measured at 25 percent production, and 14 days when measured at 50 percent production. Since severe feed restriction was practiced during a six-week period after some of the restricted grown pullets were in production, it is probable that this treatment was a major factor in delaying the attainment of the 25 percent level of production.

In this research it was found that egg production was not different in the two groups of birds, but that the production pattern differed. The groups grown with feed restriction laid at a faster rate during the latter portion of the production cycle. It was found also that there was no difference in egg weight at any given age. Laying house mortality was lower for the restricted birds than among those fast-grown on a high protein feed (25.15 percent) full feed. Fertility and hatchability did not differ significantly, although there was a slight and consistent advantage for the slow grown pullets.

Milby and Sherwood (6) reared pullets by full and restricted feeding both in confinement and on range. They restricted the feed from six weeks of age until the beginning of production to 85 percent of the feed consumed by the full fed pullets in confinement and 70 percent of the full fed pullets on range. This significantly reduced body weight and increased age at sexual maturity 10 to 15 days. Restricting the feed did not result in any saving in feed cost, primarily because of the longer feeding period required to reach sexual maturity. They found no real effect on egg pro-

duction, egg weight on any calendar date, body weight after six weeks of production, fertility, hatchability, or laying house mortality.

Progress reports from this station on some of the studies summarized here have been presented (7, 8, 9).

Experimental

Throughout the studies to be reported, customary management practices were followed. Starting, growing, and laying feeds were used, the change being made at the usual times. For some experiments commercially mixed branded feeds were used, for other experiments custom mixed New England College Conference formula feeds were used. Whenever feed restriction was practiced, sufficient feeder space was allowed so that all chickens could eat at one time. All feeds used were of the type termed "high efficiency" or "high energy" at the time the experiment was conducted.

Vaccination and immunization for disease control was according to accepted practice for this area at the time. Drug medication, except in one experiment specifically mentioned, was limited to the use of a coccidiostat for coccidiosis control.

Artificial light was used to maintain a minimum 14-hour day, regardless of season of year or age of the chickens. This practice was based on research at this station demonstrating that chickens hatched in the fall months can be delayed in sexual maturity about two weeks, when grown under conditions of uniform 14-hour light as compared to chickens subjected to the conditions of natural daylight (10, 11). Since we were interested in delaying sexual maturity, it seemed logical to make use of this management practice and determine what delay might be obtained by the feeding program.

Culling was not practiced at any time. On occasion it was necessary to adjust pullet numbers to available housing space. This was done by random selection and distribution of the pullets to be used.

For determining pullet age at a particular production level, an average of three days' egg production was used to determine the percentage egg production. Average egg size to 50 percent egg production level was measured by weighing all eggs laid to this specific time and dividing by the number of eggs weighed. In order to obtain the egg size distribution throughout an experiment, the usual type of commercially manufactured farm egg grader was used. Up to the point of 50 percent egg production each day's eggs were graded. After the time of 50 percent egg production, one week's eggs out of every four weeks' production was used (25 percent sample). The number of eggs per hen was figured on a hen-day basis.

Since the initial program for restricted feeding was of field origin, the first two experiments (No. 1 and 3) were an attempt to evaluate this program under controlled conditions.

The first experiment was started in November, 1952, utilizing a commercial strain of meat-type New Hampshire stock. One hundred and fifty straight run chicks were randomized into each pen with the cockerels removed at twelve weeks of age. The feeding treatments were as follows:

Full Fed

Mash was kept in the hoppers at all times. Starting mash was fed to 12 weeks of age and growing mash from 12 to 20 weeks of age.

Restricted

For the first two weeks the chicks were full fed. Starting at two weeks of age, the feeding time was gradually reduced (approx. 1 hour per week) until, at seven weeks of age they were limited to four hours of mash feeding each morning. Enough mash was placed in the hoppers so that at the end of the four-hour feeding period the hoppers were empty. Starting at two weeks of age the chicks were fed oats, increasing the amount as rapidly as possible until the oats comprised 25 percent of the total feed. The oats were fed at 4:00 p.m. This system of feeding was continued until the pullets were 20 weeks of age. Starting mash was fed for the first 5 weeks and growing mash from 5 to 20 weeks of age. Sufficient hopper space was provided so that all chickens could eat at the same time.

Because of limited laying house facilities, at 16 weeks of age a random sample of 35 pullets was moved to the laying pens. At 20 weeks of age each pen was placed on the same feeding program for the laying period. This program consisted of feeding a 15 percent protein all-mash breeder feed supplemented with a 20 percent protein breeder mash pellet and whole oats. Laying house records were obtained to 52 weeks of age.

The data from this experiment is presented in Table 1.

Experiment 3 was a repetition of Experiment 1. The only change in the feeding program was that in the restricted feeding system enough mash was placed in the hoppers so that at the end of the four-hour feeding period mash was left in the hoppers. At this time the hoppers were removed from the pens. This procedure was adopted because it made the mechanics of handling the experiment simpler and insured availability of feed for the four-hour period.

The experiment was started in October, 1953, with duplicate groups on each feeding program. Meat-type New Hampshire chicks from the same commercial source as used in Experiment 1 were utilized. At the start 122 chicks were randomized into each pen. Cockerels were removed at 10 weeks of age.

The data from this experiment is presented also in Table 1.

Since the results from Experiments 1 and 3 indicated that feed restriction on a time basis was not too successful and at certain periods may result in no feed restriction, attention was turned to feed restriction on a poundage basis.

Experiment 4 was designed to compare full feeding with an 80 percent of full feed program utilizing spring-hatched, range-reared stock. The same commercial source of New Hampshire chicks as used in previous experiments was utilized. The experiment was started in March, 1954, with duplicate pens for each feed treatment and 112 sexed pullet chicks randomized into each pen.

For the full fed groups the all-mash feeding system was used throughout the rearing period. Starting mash was fed to 6 weeks of age after which growing pellets were fed to 20 weeks of age. The restricted groups were full fed to six weeks of age with starting mash. Small quantities of oats

Table 1. Summary of Results with Confinement Reared New Hampshire Pullets Full Fed and Restricted Fed on a Time Basis.

		Experiment 1		Experiment 3	
		Full Fed	Restricted Fed	Full Fed	Restricted Fed
Feed restriction	%	—	11.6	—	11.2
Feed per pullet to 20 wks.	lbs.	26.9	23.8	29.4	26.1
Age at 25% production	days	158	174	164	175
Age at 50% production	days	170	178	186	186
Ave. egg size to 50% prod.	oz/doz	19.9	22.1	21.6	21.9
Ave. egg size during week in which rest'd pullets reached 50% production	oz/doz	21.2	22.2	22.8	22.7
Pullet weight — 20 wks.	lbs.	5.3	4.8	4.9	5.0
24 wks.	lbs.	6.1	6.0	5.4	5.5
28 wks.	lbs.	6.3	6.1	5.9	6.0
Feed per pullet 20-28 wks.	lbs.	15.5	15.5	18.4	18.5
Feed per bird to 52 wks.	lbs.	97.5	95.1	100.3	98.4
Eggs per bird	no.	103	110	98.1	93.9
Laying house mortality	%	17.1	5.7	13.9	13.0
Hatching eggs, 21-27 oz/doz	%	81.3	87.0	78.7	76.8

were fed also to accustom the chicks to the oats. At six weeks of age a change was made to growing pellets, 20 percent feed restriction was started and of the total amount of feed allowed, whole oats made up approximately 25 percent. The pullets were fed on this basis to 20 weeks of age.

At eight weeks of age the pullets were moved to range plots of one-quarter acre each. The vegetation was only moderately good and contained some ladino clover. From 8 to 20 weeks of age, both treatment groups could eat as they wished of the range vegetation, with the restricted treatment being limited to 80 percent of the feed consumed by the full fed treatment groups.

At 20 weeks of age the pullets were moved to laying pens. Feed restriction was continued until five percent production was reached, at which time the pullets were placed on full feed.

The data from this experiment is presented in Table 2.

In view of the results obtained up to this time there was considerable interest in the extent to which pullets might be delayed in egg production. For this reason, in Experiment 6 more severe feed restriction was practiced starting at the early age of two weeks.

Experiment 6 was started in November, 1954, and the pullets were grown in confinement. Duplicate pens of 45 sexed pullet chicks from the previously used commercial strain of New Hampshires were used. The chicks were full fed to two weeks of age at which time the treatments of full feed, 80 percent, and 70 percent of full feed were established. All-mash feeds were used throughout the experiment with the starting feed being fed to eight weeks of age after which time a growing feed was used. At 20 weeks of age all groups were fed an all-mash breeder ration.

The data from Experiment 6 is presented in Table 2.

At this period in the development of the research, current comment was to the effect that restricted feeding should be used for rearing all types of chickens, not only meat-type chickens to be used for the production of hatching eggs. For this reason it was decided to conduct experiments using White Leghorn stock. Two experiments were conducted using the same commercial strain of White Leghorn chicks for each experiment.

Experiment 7 was started in April, 1955, with duplicate pens of 78 sexed White Leghorn pullet chicks on each feed treatment. The chicks were brooded and full fed to six weeks of age at which time they were moved to range and the treatments of full feeding and restricted feeding were started. The experimental design was developed on the basis that 70 per cent of full feeding would be studied. However, due to an outbreak of Blackhead disease in all experimental groups, it was necessary, for a period of about three weeks, to full feed the restricted groups in order to secure adequate feed and drug intake to control the disease problem. Following control of the disease, restricted feeding again was practiced at the 70 percent of full feed level. Over-all restriction amounted to 21.3 percent.

At 20 weeks of age the pullets were moved to the laying pens. Feed restriction continued until 23 weeks of age, at which time the full fed groups were laying their first eggs. At this age feed restriction was terminated and full feeding of both groups was practiced.

The all-mash feeding system was used throughout the experiment. Starting mash was fed to six weeks, growing pellets while on range, and breeder mash during the laying period.

The results from this experiment are presented in Table 3.

Table 2. Summary of Results with New Hampshire Pullets Full Fed and Restricted Fed on a Poundage Basis.

		Experiment 4* (Range Reared)		Experiment 6† (Confinement Reared)		
		Full Fed	Restricted Fed	Full Fed	Restricted Fed	Restricted Fed
Feed restriction	%	—	20.4	—	20.4	29.0
Feed per pullet to 20 wks.	lbs.	25.8	20.6	28.3	22.6	20.0
Age at 25% production	days	166	175	172	177	184
Age at 50% production	days	176	186	186	188	193
Ave. egg size to 50% prod.	oz/doz	21.1	21.9	23.0	22.0	22.4
Ave. egg size during week in which rest'd pullets reached 50% production	oz/doz	21.8	22.4	23.2	22.9	22.7
Pullet weight — 20 wks.	lbs.	5.1	4.2	5.7	4.9	4.5
24 wks.	lbs.	5.4	5.5	6.7	6.2	5.9
28 wks.	lbs.	6.1	6.0	6.6	6.3	6.2
Feed per pullet 20-28 wks.	lbs.	17.7	16.9	18.0	19.1	19.1
Total feed per bird	lbs.	122.6	116.2	97.6	91.1	90.3
Eggs per bird	no.	113	115	96.8	97.4	97.4
Laying house mortality	%	11.5	13.1	22.8	14.3	22.8
Hatching eggs, 21-27 oz/doz	%	83.9	89.1	89.8	88.6	91.6

* 60 weeks
† 52 weeks

Experiment 8 was conducted as a repetition of Experiment 7. The same commercial White Leghorn stock was used. Duplicate groups of 117 sexed pullet chicks were started in March, 1956, for each feeding treatment. The chicks were brooded to 8 weeks of age, moved to range where they remained until 22 weeks of age, at which time they were housed.

An all-mash feeding system was used for the experiment. Starting mash was fed to six weeks of age at which time a change was made to growing mash. While on range the feed was in pellet form. At 23 weeks of age breeder mash was fed.

Since in the previous experiment with Leghorns the feed restriction approximated 20 percent, this degree of restriction was studied in this experiment. Feed restriction was practiced from six to 23 weeks of age.

The data from Experiment 8 is presented in Table 3 together with the data from Experiment 7.

Attention is now called to the fact that all experiments thus far reported here were conducted with a uniform minimum 14-hour day by means of artificial lighting, regardless of season of the year, or age of the chickens. This procedure resulted from original research at this station (10, 11) demonstrating that fall-hatched pullets could be delayed approximately two weeks in sexual maturity by use of a uniform 14-hour day. Since application of artificial light is one of the simplest management practices to use, this procedure was used throughout the experiments. In addition, to measure only feeding effects, it was desirable to eliminate light effects in so far as practicable. Skoglund (12) has shown that, depending upon date of hatch, sexual maturity may be delayed by as much as one month when artificial lighting was not used.

Since proper application of artificial light and restricted feeding each have an effect in delaying sexual maturity, Experiment 9 was designed to measure whether these effects were additive.

For Experiment 9 a November, 1956, hatch of chicks was used, since it is the fall hatches which are most stimulated to early sexual maturity by natural daylight. To measure the combined effects of 14-hour lighting and restricted feeding, this treatment was compared with a program of natural daylight and full feeding. A meat strain of White Plymouth Rock chicks was used. Triplicate pens of 42 pullet chicks each were used for the experiment. Feed restriction was started at 6 weeks and continued to 20 weeks of age at which time the full fed pullets were in production. Other management practices were the same as used in previous experiments.

The results of Experiment 9 are presented in Table 4.

Results and Discussion

The results from the first two experiments, presented in Table 1, in which feed restriction was practiced on a time basis, show that feed restriction was only moderate. In fact, after 16 weeks of age, little restriction was evident in Experiment 3. This may have been true at an earlier age in Experiment 3 and possibly also in Experiment 1. However, experimental methods in use at the time did not accumulate the necessary data.

In Experiment 3 at 16 weeks of age it was noted that feed restriction was slight between 12 and 16 weeks of age. For this reason weekly feed

Table 3. Summary of Results with Range Reared White Leghorn Pullets Full Fed and Restricted Fed on a Poundage Basis.

		Experiment 7		Experiment 8	
		Full Fed	Restricted Fed	Full Fed	Restricted Fed
Feed restriction	%	—	21.5	—	17.6
Feed per pullet to 23 wks.	lbs.	18.3	14.4	19.0	15.6
Age at 25% production	days	172	181	171	179
Age at 50% production	days	183	194	180	195
Ave. egg size to 50% prod.	oz/doz	21.4	21.8	20.9	21.4
Ave. egg size during week in which rest'd pullets reached 50% production	oz/doz	21.9	22.4	21.7	21.5
Pullet weight — 23 wks.	lbs.	3.1	2.7	3.1	2.6
28 wks.	lbs.	3.5	3.3	3.7	3.6
32 wks.	lbs.	3.3	3.2	3.6	3.5
Feed per pullet 23-32 wks.	lbs.	13.5	13.7	13.9	14.1
Feed per bird to 60 wks.	lbs.	78.2	74.1	82.2	79.9
Eggs per bird	no.	123.0	116.3	136.2	137.0
Laying house mortality	%	36.8	24.8	19.6	13.4
Hatching eggs, 21-27 oz/doz	%	83.1	88.3	86.9	88.0

consumption records were taken for the next four weeks. The data showed that the full feed pullets ate 1.90, 1.88, 1.95, and 2.18 pounds of feed per bird per week, while the restricted pullets, with four hours feeding time, ate 1.91, 1.91, 1.95, and 1.88 pounds of feed per bird. Thus there was virtually no feed restriction during this 16- to 20-week period. Since there was an 11.2 percent restriction of feed during the 20-week period, this restriction must have occurred before 16 weeks of age.

Table 2 presents the results with pullets restricted in feed consumption on a poundage basis, when grown in confinement and on range.

It would appear that equivalent feed restriction results in less delay in maturity when pullets are confinement reared as compared with range rearing. However, the experiments were run in different years and different feeds were used, although the stock was the same. Since year and feed may have had some effect, it cannot be said that equivalent restriction of feed results in less delay in maturity in confinement than on range.

While early egg size, as measured by average weight of all eggs laid to 50 percent production, is generally larger for the restricted fed pullets, this is not always true as shown by the results of Experiment 6. Also it is evident that when egg size is measured at a specific time after the restricted fed pullets are in production, there is little difference between the two groups in egg size. This is due to the high correlation between egg size and chronological age of the pullet (13, 14). In a given experiment the two differently fed groups of pullets are the same age at all times, hence the egg size should be approximately the same.

Pullet weight was markedly affected by the feed allowance, as would be expected. However, this weight was made up following four to eight weeks of full feeding. Surprisingly, this is accomplished without the consumption of additional feed. Hence feed saved by restriction during the

Table 4. Summary of Results with Confinement Reared White Plymouth Rock Pullets Full Fed with Natural Daylight and Restricted Fed with 14-hour Light During the Brooding and Growing Period; Experiment 9.

		Natural Daylight Full Fed	14-hour Light Restricted Fed	Difference
Feed restriction	%	—	15.6	
Feed per pullet to 20 wks.	lbs.	25.8	21.8	4.0**
Age at 25% production	days	177	184	7
Age at 50% production	days	190	201	11*
Ave. egg size to 50% prod.	oz/doz	19.4	21.1	1.7*
Ave. egg size during week in which rest'd pullets reached 50% production	oz/doz	21.7	22.1	0.4
Pullet weight — 20 wks.	lbs.	5.3	4.8	0.5*
24 wks.	lbs.	5.9	5.7	
28 wks.	lbs.	6.1	6.0	
Feed per pullet 20-28 wks.	lbs.	15.2	15.8	
Feed per bird to 60 wks.	lbs.	102.2	98.8	3.4
Eggs per bird	no.	118.9	129.2	10.3
Laying house mortality	%	19.8	23.5	3.7
Hatching eggs, 21-27 oz/doz	%	63.4	72.5	9.1

*, ** Significant at the 5 and 1% level of probability, respectively

growing period is not lost at this particular time in the production period. Likewise total feed consumption at the end of the production period mainly reflects the difference in feed consumption during the growing period.

The data for egg production, mortality, and percentage hatching eggs show small differences not always in the same direction.

The results from Experiment 6 for the groups restricted 29 percent in feed intake are of interest. As mentioned previously, at this particular time we wished to measure sexual maturity delay as the result of what was felt to be a severe restriction program. For this reason confinement rearing was practiced, 30 percent restriction was chosen, and the restriction program started at two weeks of age. This management program resulted in a marked reduction of 8 pounds in feed intake with a resulting decrease of 1.2 pounds in body weight at 20 weeks of age. However, during the production period, these pullets performed as well as pullets full fed or less severely restricted during the growing period.

The data in Table 3 is presented to show that light breed chickens respond to restricted feeding in essentially the same way as do heavy breed chickens.

In order that one may see the average results to be expected from restricted feeding, Table 5 has been prepared. This table presents the average results for Experiments 1 through 8 for the more important points under consideration. Also the difference between these averages is presented. An indication of the significance of the figures was obtained by calculation of the statistic "t" for difference between means divided by the standard error of the difference. Experiment 9 was not included in this table of average results since the feed treatments in this experiment were combined with lighting programs to measure combined effects.

Study of the data in Table 5 indicates that the outstanding advantage of restricted feeding during the growing period is the feed saved, and the resulting economy, in growing a pullet. An approximate 20 percent reduction in the feed allowed during the growth of a pullet results in a saving of 4 to 4.25 pounds of feed, decreases the pullet weight about one-half pound, and delays sexual maturity 8 to 9 days, without any apparent harm or major influence on results obtained during the laying period. The feed saved during the growing period is not consumed at a later date to make up the body weight as is evident from the feed consumption records obtained during the period when this weight is made up. Further evidence for this fact appears also in the total feed consumption data. The difference in total feed consumed is essentially the difference in feed consumed during the growing period.

While there is an actual delay in production of first eggs by the restricted fed pullets, there is considerable tendency also for the restricted fed pullets to lay at a slower rate until the body weight is made up. Since there is no appreciable difference in feed consumption at this time, it would appear that feed was being used for weight gain at the expense of egg production. Following the attainment of body size there comes increased production with a general tendency for the restricted pullets to reach a little higher peak of production. It is during this period that the restricted fed pullets catch up in number of eggs with the full fed pullets which started laying at an earlier age. However, since mature egg size has not been attained at this time, all of the additional eggs laid by the restricted fed pullets are not additional hatching eggs. Hence the end re-

sult is equivalent numbers of eggs for the two groups and a small increase of two or three hatching eggs per bird for the restricted fed pullets.

Table 4 presents results for the combined effects of restricted feeding and artificial light on fall-hatched pullets. In general the results do not differ from those obtained in the experiments conducted with 14-hour lighting. Likewise the results do not differ from those obtained in experiments in which lighting effects alone have been studied (10, 11). This would indicate that lighting effects and restricted feeding effects are not additive in altering sexual maturity and associated factors in pullets grown during the shorter daylight periods of the year. Hence either artificial lighting, restricted feeding, or the combination of both practices will produce the same end results. Artificial lighting offers the advantage of simplicity, ease in usage and low cost while restricted feeding offers the advantage of feed saving and economy although it is more difficult to apply.

Table 5. Summary of Average Results from Experiments 1-8.

		Full Feeding	Restricted Feeding	Difference
Feed per pullet to termination of restriction	lbs.	24.4	20.2	4.2*
Pullet wt. at termination of restriction	lbs.	4.48	3.94	.54
Age at 25% production	days	168	177	9 **
Age at 50% production	days	180	188	8 **
Ave. egg size to 50% production	oz/doz	21.5	21.7	.2
Ave. egg size during week in which rest'd pullets reached 50% production	oz/doz	22.2	22.4	.2
Total feed per bird	lbs.	96.3	92.2	4.1
Eggs per bird	no.	112	112	0
Mortality in laying house	%	21	15	6
Hatching eggs, 21-27 oz.	%	84	86	2

* Significant at the 5% level of probability

** Significant at the 1% level of probability

In general the results from these experiments, conducted during the period from 1952 to 1958, agree with reports published during the course of this research (Milby and Sherwood, 1953; Sunde *et al.*, 1954; Singsen *et al.*, 1954; Davis and Watts, 1955; Schneider *et al.*, 1955; Milby and Sherwood, 1956). Schneider *et al.* (5) were the only workers to report significantly lower mortality in the laying house (13.2 percent) for the "slow" grown pullets. They state that the exact reason for this difference in results is not known. They suggested that in part this difference may be due to extremely high protein feeding to the "fast" grown pullets and to severe restriction practiced on the "slow" groups for a period of six weeks after the "fast" groups were fed laying mash. The author would add also that only one experiment was reported and variability at times can become quite large.

An incidental observation from these experiments has been that feather pulling and cannibalism has never been a problem. Perhaps this may be accounted for in part by the fact that care was always exercised that adequate feeder space was available so that all chickens could eat at the same time.

Summary

Restricted feeding of growing pullets has been investigated in a series of seven experiments conducted over a six-year period. Heavy breed and light breed stock was used, range and confinement rearing was practiced, feed restriction on a time and poundage basis was studied, and the combined effects of artificial lighting and restricted feeding were investigated.

Restricted feeding of mash on a 4-hour time basis, supplemented with whole oats to equal 25 percent of the total feed, results in only moderate feed restriction. In one experiment there was essentially no restriction of mash consumption when mash was available for 4 hours daily during the period 16 to 20 weeks of age.

Restricting the feed during the growing period 20 percent or more on a poundage basis decreases feed intake, reduces pullet weight, and delays sexual maturity 8 to 9 days. Restricting the feed had no significant effect on subsequent egg production, egg weight on any calendar date, laying house mortality, or percentage of hatching eggs. Differences which did develop tended to favor restricted feeding.

Range-reared and confinement-reared pullets, and heavy breed and light breed stock react in the same manner to restricted feeding.

November-hatched pullets subjected to 14-hour lighting and restricted feeding react in essentially the same manner and to the same degree as pullets managed only on a restricted feeding basis. Artificial lighting effects and restricted feeding effects are not additive in altering sexual maturity and associated factors. Hence either artificial lighting, restricted feeding, or the combination of both management practices will produce the same end results.

Recommendations

The outstanding advantage of a restricted feeding program lies in the feed saved and the resulting economy in the cost of growing a pullet. For this reason it is recommended to those who wish to use it. Like any feeding system, good management and sound judgement are important factors in the successful operation of a restricted feeding program.

Since restricted feeding differs markedly from feeding systems in common usage in the past, perhaps a few suggestions and cautions for operation of the program will be helpful.

Suggestions

1. To be most successful, restricted feeding should be started when the pullets are six to eight weeks of age.

2. Restrict 20 percent on a poundage basis.

3. Feed twice daily.

4. Amount to feed. One of the more difficult aspects of the program is determination of the amount of feed to be used each day. Table 6 may be used as a restricted feeding guide. As the name implies, it is only

a guide. The actual amount of feed consumed by any full fed flock will vary with the feed, stock, season of the year, range or confinement, and size of the pullet.

Table 6. Restricted Feeding Guide. Approximate Pounds of Feed per Hundred Birds per Day.*

Age	Heavy Breeds	Light Breeds
wks.	lbs.	lbs.
6	11	8
7	12	9
8	13	10
9	14	11
10	15	12
11	16	13
12	17	14
13	18	15
14	19	16
15	20	17
16	21	17
17	22	17
18	23	17
19	23	17
20	23	17

* Quantity of feed allowed may be related to age. Heavy breeds — age plus five until 23 pounds is fed; light breeds — age plus two until 17 pounds is fed.

Cautions

1. Size of flock. In confinement rearing or where feed is placed in troughs, small groups of pullets (400-500) are more successfully managed than large groups (1000 or more). The pullets become very hungry and will crowd around the attendant and the feeders at feeding time. Losses can occur from piling and smothering.

2. Feeding space. Pullets on a restricted feeding program need enough feeder space so that all pullets can eat at the same time. Allow at least six inches of feeder space per pullet or five five-foot troughs per hundred pullets. Without adequate feeder space a restricted feeding program will not be successful.

3. Feeding schedule. Pullets on a restricted feeding program adapt themselves to the feeding schedule. At feeding time they are very hungry, ready and anxious for feed. Failure to feed on schedule may lead to feather picking and other vices. Feed on schedule.

4. Drug medication in the feed. Restriction of feed intake also restricts drug intake. Hence, recommended levels of a preventative drug in the feed may not be adequate in a restriction program.

5. Disease problems. If disease develops, full feed until the problem is corrected.

6. Culling. At housing time culling for health only should be practiced.

7. Type of feed. While the general features of the restricted feeding program as recommended are applicable to use of several types of feed, the Feeding Guide is based upon the feeding of a high energy all-mash or "complete" feed. One should not attempt to feed a low energy, bulky, or more fiberous feed on a restricted basis. For those who wish to feed oats or to make other modifications in the feeds used, it is suggested that you consult with your feed supplier in order that the right type of feed may be selected.

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